



PHARMACOLOGICAL SIGNIFICANCE OF MEDICINAL HERB

Ocimum gratissimum Linn (Faranjmishk): AN UPDATED REVIEW

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ABSTRACT

Ocimum gratissimum, known as Faranjmishk; is a well-known plant used in Unani system medicine. It is used in treatment of various diseases such as pneumonia, diarrhoea, headache, diabetes, bacterial and fungal infections. The bioactive compounds extracted from O.G. includes flavonoids, terpenoids, saponins, phenolic compounds, glycoside, beta carotene, anthraquinones, essential oils (thymol, P-cymene, Yterpenes, limonene, eugenol, phenylpropene, sesquiterpenes, germacrene-D, 1,8-cineole, Beta selinene, caryophyllene etc.). Various studies have shown that O.G. and its components possess pharmacological properties such as antimicrobial, antifungal, antidiabetic, anxiolytic, anticancer, antibacterial, antidepressant etc. However, despite of high medicinal benefits and pharmacological activities of O.G., the essential of O.G. is capable of invoking inflammatory response on persistent administration; hence toxic potentials of plant should not be overlooked. This review consisting of references from literature search of journals, using different search engines and chapters in books aims to highlight the medicinal values, pharmacological action, morphological effects and toxicity of O.G.

Keywords: *Ocimum gratissimum*, Pharmacological actions, Unani drug, Faranjmishk

INTRODUCTION:

The use of medicinal plants in traditional and complementary medicine for the treatment, management or prevention of various diseases is as old as the origin of mankind [1]. It has been estimated that 80% of world's population rely traditional medicines for their primary needs. The recent increase in preferences for the use of herbal medicines over conventional may be attributed to the efficacies of the active ingredients present in the herbal medicine as well as their availability, accessibility and affordability [2].

Ocimum grattissimum (O.G.), popularly known as Faranjmiskh in Unani, has been extensively used for various ailments. It is widespread perennial herbaceous plant, about 1.2-1.8 m tall with very strong aromatic smell. It belongs to the family Lamiaceae and is found in Africa, Asia and South America [3]. Several scientific reports already confirmed the presence of wide range of bioactive compounds such as flavanoids and polyphenols [4] and essential oil [5] with several beneficial effects. Furthermore, several pharmacological studies confirmed that this plant possesses pharmacological activities such as Antimicrobial [6, 7] Antifungal [6], Antioxidant [6], Anxiolytic [8], Hepatoprotective [9], Immunomodulatory [10], antidepressant [10] etc.

In Unani medicine its leaves and seeds are used as medicine and it is documented to be cardiotoxic [11, 12, 13, 14] braintonic, demulcent [15, 16], hepatotoxic [11, 12, 13, 17], resolvent [13], aphrodisiac [13] and recommended for Surkh badda [12], Malikholia [12], Khafqaan [11, 13, 14, 17], Qula, [12], Warme-lissa [11, 12, 13, 17].

In the past few years, demand of essential oils derived from almost all parts of aromatic plants has increased due to their importance in native medicine systems [18]. Essential oil extracted from O.G. showed a yield % of 0.12-1.66 %. The main component is phenylpropenes (57.3%) followed by sesquiterpenes (27.5-38.1%) and monoterpenes (4.0%-16.1%) [19]. Essential oil reported to possess interesting biological properties including application in perfumery, aromatherapy, food preservative etc.

This study aims to provide comprehensive and updated information on the medicinal uses, phytochemicals and pharmacological activities of O.G. This paper also provides useful information on the beneficial effects of O.G and identifies gaps in the current knowledge that can encourage further investigation into effectiveness and commercialization of O.G. in the treatment of various diseases.

TAXONOMICAL CLASSIFICATION [18]

Kingdom : Plantae

Subkingdom : Tracheobionta
 Super division : Spermatophyta
 Division : Magnoliophyta
 Class : Magnoliopsida
 Subclass : Asteridae
 Order : Lamiales
 Family : Lamiaceae
 Genus : *Ocimum*
 Species : *Gratissimum*

VERNICULAR NAMES [9, 11, 12, 15, 16, 20, 21]

- Arabic: Furanjmishk, Faranjmishk
- Persian: Palangmishk
- English: Large Basil, Lemon Basil, Shrubby Basil
- Gujarati: Avachibavachi, Ram tulsi
- Hindi : Ban tulsi, Ram tulsi
- Urdu : Ramtulasi
- Unani: Afnees, Aqeles, Oqelus
- Bengali : Ban tulsi, Ram tulsi
- Kannada: Nimma tulsi, Rama tulasi
- Malayalam : Kattu trittavu
- Marathi : Ram tulsi, rana tulasu
- Oriya: Ramotulosi
- Punjabi : Banjere
- Telugu : Nimma tulsi, Rama tulasu

DISTRIBUTION [9, 20]

Furanjmishk is found throughout India, often cultivated in Ceylon, Java, tropical Africa, Native country not known for certain. A broadly distributed palaeotropical species of unknown origin, originate almost everywhere in India as a

common wild plant by roadsides and in waste places and also frequently cultivated.

DESCRIPTION OF PLANT IN UNANI (MAHIYAT) [11, 13, 22]

Furanjmishk is a type of Rehan or Tulsi but its leaves and trees are slightly bigger than tulsi. It has the strongest fragrance among all varieties of tulsi. Its plant and stem are bigger than Rehan and fragrance is as strong as clove hence it is called as Rehan Qaranfali. It grows in desert, forests, rocky lands and also cultivated where is literature Qaranfal Bustani is mentioned it is actually Faranjmishk, sometime Habaqe Qaranfali, Rehan Qaranfali and Qantariyoon Ghaleez are also used instead of the above mentioned. It smells like Mushk hence it is called Furanjmishk. It has two types first is Bustani which is also called Hindi and the second type is called Chini It's branches are square in shape and leaves are similar to barge- baadrooj and its colour is greenish yellow, hairy, smells like qaranfal, flowers are small and blackish, seeds are similar to Cumin and it's colour looks like greenish black but it is more conical and smaller than Tukhm Balangu.

MORPHOLOGY OF PLANT

Macroscopic: A tall, much branched perennial shrub, 1-2.5-meter height, found almost throughout India and in Laccadive Islands. It is often cultivated. Leaves 6.3-12.5 by 3.8-5.7 cm., elliptic-lanceolate, acute, coarsely crenate-serrate, gland-

dotted, pubescent on both sides, base cuneate petioles 2.5-6.3 cm. long, slender, more or less pubescent [16]. Flowers in simple or branched rather short racemes, in tolerably close whorls; rhachis quadrangular, softly pubescent; bracts sessile, longer than the calyx, acuminate from a broad ovate base. Decussate and squarrose in the young inflorescence, ciliate; pedicels shorter the calyx, softly pubescent. Calyx 3 mm. long in flower, becoming twice as long in fruit, pubescent and glandular; upper lip rounded, veined, scarcely mucronate, curved upwards in fruit, longer than the lower; lower lip strongly nerved, the 2 central teeth short, subulate, the lateral teeth shorter and broader, lanceolate; Corolla 4 mm. long, pale greenish yellow pubescent outside; upper lip 3 mm. broad with 4 rounded teeth; lower lip longer than the upper, 1.25 mm. broad. Stamens exerted; upper filament with a bearded tooth at the base. Nutlets 1.5 mm. diam. subglobose, rugose, brown [9]. *Ocimum gratissimum* is more strongly scented than other species of the genus. It is mosquito repellent and its cultivation is recommended as a means of controlling measure for this pest. The characteristics and composition of the volatile oil obtained from plants growing in different areas vary. Two types of oil may be distinguished, one containing thymol as the chief constituent and the other eugenol.

The former is obtained from plants grown in Ivory Coast and Central Africa; the later type of oil is obtained from plant grown in Seychelles.

MICROSCOPIC STUDIES: [6, 23]

The lamina cross section shows two zones: a slightly curved midrib at the top and convex lower face and the thinnest blade face. Midrib shows two epidermises upper and lower, In the middle of the blade and mesophyll which contains different tissues like primary wood and primary phloem, collenchyma and medullary parenchyma. The epidermis contains rows of palisade cells and also highly cutinized. On the upper side of blade detectors of bristles are present. The rounded cells of spongy parenchyma in which some of them are isolated sclerotized. The collenchyma which is contain under the epidermis in without meatus and formed of the cells which are uniformly thick. The parenchyma is more abundant on the lower side. The vascular system lives closed bow with a sheath of primary phloem and primary wood in a forms a beam. Medullary parenchyma is actual small.

The cross section of hexagonal stem consists of two parts: The central cylinder and bark. The thin bark consists of three primary tissues i.e. epidermis, cortical, collenchyma and parenchyma. The thin wall of epidermis consists of a single base of small adjoining rectangular cells and

cellulose. The cortical parenchyma has multiple layers of thin wall polygonal cells. The central cylinder is highly developed than the bark. A fundamental parenchyma which differs from primary tissues is observed (phloem parenchyma wood, spinal cord) and two secondary tissues (secondary phloem and wood). The primary wood is centrifuged and the secondary wood and secondary phloem are aligning in radial pattern. The core of parenchyma is formed of large polygonal cells includes meatus and cellulose walls.

CHEMICAL COMPOSITION:

The phytochemical constituent of the plant displays the presence of numerous bioactive compounds. The aqueous leaf extract confirmed the presence of steroids, tannins, flavonoids, terpenoids alkaloids, inulins, saponins, phenolic compounds, glycosides, β -carotene [24-25] reducing sugars, carotenoids, phlobatannins, cardiac glycosides and anthraquinones [26]. Beside these quinones, polyphenols, catechins and coumarins, [27] were also detected in aqueous extract. The methanolic leaf extract confirmed the presence of flavonoids, tannins, alkaloids, phlobatannins, terpenoids, and cardiac glycosides along with steroidal ring [28, 29]. The ethanolic extract consists of alkaloids, flavonoids, steroids, tannins, phlobatannins and terpenoids [30]. The ethanolic leaves extract confirmed the

presence of phenolic compounds, saponins, terpenoids, anthraquinones, carbohydrates and sterols [31]. Petroleum ether leaves extract showed the presence of highest flavonoid [26]. The whole plant has the presence of essential oil thymol, p-cymene, γ -terpene, β -phellandrene, t-sabiene hydrate, limonene, eugenol spathulenol, eugenol, geraniol, eugenol γ -muurolene, gratissimol, 1,8-cineole, germacrene-D and external flavones and β -caryophyllene mainly xantomicrol and cirsimaritin [8, 32]. Alongside with these plant leaves also contains β -selinene and some other essential oil like monoterpenes, sesquiterpenes and hydrocarbons and other components [33]. The plant seed mucilage consists of hexoses, pentoses, uronic acid and lipids [34] and essential oil thymol and eugenol [7].

MIZAJ (TEMPERAMENT):

Hot² and dry² [11, 12, 13, 14, 17]

HISSA MUSTAMELA (PART USED):

Seeds [11, 13, 14]

Leaves [11, 13, 14]

MIQDARE KHURAK (THERAPEUTIC DOSE)

Leaves 10.5 g [11]

Leaves 10 g [13]

Leaves 3 g [17]

Seeds 7 g [11, 13]

Seeds 5-7 g [14]

Seeds 2 g [17]

PHARMACOLOGICAL ACTIONS:

- *Mufarrah* (Exhilarant) [14, 35]
- *Dafe-Suddad* (Deobstruent) [11, 12, 13, 14, 17]
- *Muqawwie- Qalb* (Cardio tonic) [11, 12, 13, 14]
- *Muqawwie- Meda* (Stomachic) [11, 13, 14]
- *Muqawwie- Jigar* (Liver tonic) [11, 12, 173, 17]
- *Hazime-Taam* (Digestive) [11, 12, 13, 16, 17]
- *Muhallile-Riyah* (Carminative) [11, 13, 14, 15, 17]
- *Muqawwie-Bah* (Aphrodisiac) [13]
- *Qabize-Shikam* (Intestinal astringent) [11, 12, 14]
- *Dafe istihaza* (Antimenorrhagic) [11, 12, 14]
- *Mujaffife-Mani* (Semens siccative) [11, 13, 17]
- *Muqawwie Lissa* (Strengthen gums) [11, 12, 13, 17]
- *Dafe-Booe- Dahan* (Halitosis) [12, 13, 17]
- *Dafe-Zaheer* (Antidiarrheal) [13]
- *Dafe-Tashanuj* (Anticonvulsant) [13]
- *Dafe-Taffun* (Antiseptic) [14, 16]
- *Muqawwi* (Tonic) [16]
- *Muharrik* (Stimulant) [15, 16]
- *Mulattif* (Demulcent) [15, 16]
- *Mudir* (Diuretic) [15, 16]
- *Dafe-Qai* (Antiemetic) [15, 16]

- *Habisuddam* (Styptic) [15, 16]

- *Mushtahi* (Appetizer) [13]

THERAPEUTIC USES:

- *Khafqan* (Palpitation) [11, 12, 13, 14, 17]
- *Suda* (Headache) [13, 14, 16]
- *Amraze- Meda wa Ama* (Diseases of stomach and intestine) [14]
- *Zofe-Qalb* (Weakness of the heart) [14]
- *Bawaseer* (Haemorrhoid) [11,12, 13, 17, 20]
- *Suzak* (Gonorrhoea) [13, 15,]
- *Nuqras* (Gout) [13]
- *Wajaul-Aasab* (Neuralgia) [13, 16]
- *Nafakhe-Shikam* (Flatulence) [17]
- *Surkhabada* (Erysipelas) [12]
- *Fojshila* (Mumps) [12]
- *Qula* (Stomatitis) [12]
- *Iltehabe-Dast* (Swollen hand) [15]
- *Wajaul Meda* (Stomach ache) [15, 16]
- *Qai* (Vomiting) [15]
- *Suaal* (Cough) [16]
- *Zaheer* (Dysentery) [16]
- *Amraze-Boul* (Urinary Disorders) [16]

TOXICITY OR ADVERSE EFFECT (MUZIR ASRAT)

Harmful for brain, hot temperament and also produces headache [12, 13, 14, 17]

Corrective (*Musleh*)

Banafsha, (*Viola odorata* Linn.), [11, 13, 14, 17] Sikanjabeen [11, 13, 14, 17] Sandal (*Santalum album* Linn.) Rose (*Rosa damascena* Mill.) [13]

Substitute (*Badal*):

Badranjboya (*Melissa officinalis* Linn.) [11, 13, 14, 17] Til (*Sesamum indicum* Linn) [11, 13] Qaranfal (*Eugenia caryophyllata* Thunb.) [13] Shibbat (*Anethum graveolens* Linn.) [17] Tukhm Balango (*Lallemantia royleana* Benth.) [11, 13]

PHARMACOLOGICAL STUDIES:

- Antimicrobial [1, 6, 36]
- Antifungal [6]
- Antidiarrheal [1, 6]
- Antihypertensive [1, 6]
- Antidiabetic [1, 6]
- Antioxidant [1, 6, 37]
- Leishmaniscidal [1, 6]
- Anxiolytic [1, 10]
- Antiprotozoal [1]
- Analgesic [1]
- Antifertility [1]
- Hepatoprotective [1]
- Anticancer [1]
- Antinociceptive [1]
- Neuroprotective [1]
- Wound healing properties [1]
- Larvicidal [1]
- Cytotoxic [1]
- Nephroprotective [1]
- Anti-inflammatory [1]
- Immunomodulatory [1]

- Antibacterial [38]
- Antidepressant [10]

TOXICITY OF *OCIMUM GRATISSIMUM*:

Ocimum gratissimum can be used in preparing food and to treat certain ailments, but it can also cause systemic toxicity, which is dose dependent. The toxicity and phytochemical constituents of OG leaf aqueous extract were investigated, and several reducing sugar, tannins, saponins, cardiac glycosides, terpenes, steroids, flavonoid, and alkaloids were discovered. Their histological findings in the kidneys indicated acute tubular necrosis in the cortex as well as mononuclear cellular infiltration. In the lungs, they found inflammatory oedema and macrophages in the alveolar lumen, as well as thickening of the alveolar septae due to congestion and exudation, necrosis and desquamation of the bronchiole epithelium, and necrotic debris. The peri-bronchiolar area was compactly infiltrated with macrophages and lymphocytes that were focally organised. They discovered haemorrhages, focal areas of necrosis, mononuclear cellular infiltration, and hepatocytes undergoing vacuolar changes in the liver [39].

Ocimum oil has been reported to be able to induce an inflammatory response that progresses from acute to chronic upon repeated administration, and as such has

toxic potentialities that should not be overlooked [40]. OG extracts have been shown in studies to affect macrophage functions and to be hepatocarcinogenic [41]. The effect of *Ocimum gratissimum* leaf extracts on the histology of the gastrointestinal tract in rats was investigated. Their findings revealed severe necrosis of the villi and significant erosions of the mucosa and submucosa at high doses (800 mg/kg) and concluded that OG leaf extracts, while rich in bioactive compounds and may be well tolerated at low to moderate doses during short term treatment, may cause gastrointestinal toxicity when used constantly over a long period [42].

The testiculotoxic effects of *Ocimum gratissimum* on sperm quality and testicular morphology in alloxan-induced diabetic rats were investigated. When OG, diabetic, and diabetic+OG-treated rats were compared to controls, their testes showed increased abnormal sperm cells, mild vacuolation in the seminiferous tubule, disorganised germinal cells layer, arrested sperm maturation with empty spermatozoa in lumen, reduced seminiferous tubule diameter, and increased interstitial space. They concluded that diabetes caused sperm impairments and testicular cytoarchitecture distortions, which were aggravated by *Ocimum gratissimum* leaf extract in male Wistar rats [43].

CONCLUSION

Presently, the interest in herbal medicines has been greatly increasing accompanied by increasing laboratory investigation into pharmacological properties of the bioactive ingredients and their ability to treat various ailments. Following this approach numerous drugs have entered in the international market through exploration of ethnopharmacology and traditional medicine. O.G. is a plant with much potential and is useful in many diseases. Extract and essential oil obtained have gained much appreciation among food scientist and researchers because of their multifold biological activities. In spite of the wide spectrum uses of this natural medicinal plant in culinary dishes and in treatment of different ailments, its systemic toxicity, which is seems to be dose dependant must be ruled out to practice its safer therapeutic use. This reviewed article will attract the scientist and researchers interested in formulation of new drugs and supplements from natural products, with a view of contributing a lot in resolving certain economic and health issues. Keeping the aforementioned in mind, there is hope that in near future the O.T. essential oil and its constituents can be considered for more clinical assessment and application.

REFERENCES:

- [1] Ositadinma Chinyere Ugbogu, Okezie Emmanuel, Grace Oka Agi, Chibuikwe Ibe, Celestine Nwabu Ekweogu, Victor Chibueze Ude, Miracle Ebubechi Uche, Rachel Oluchukwu Nnanna, Eziuche Amadike Ugbogu, A review on the traditional uses, phytochemistry, and pharmacological activities of clove basil (*Ocimum gratissimum* L.) *Heliyon* 7 (2021) e08404.
- [2] Ijioma, S.N., Emmanuel, O., Nosiri, C.I., Ugbogu, E.A. Evaluation of toxicity profile and pharmacological potentials of Aju Mbaise polyherbal extract in rats. *Sci. Afr.* 2021, e00681
- [3] Tanko, Y., Magaji, G.M., Yerima, M., Magaji, R.A., Mohammed, A. Antinociceptive and anti-inflammatory activities of aqueous leaves extract of *Ocimum gratissimum* (Labiata) in rodents. *Afr. J. Tradit., Complementary Altern. Med.* 2008 5, 141–146.
- [4] Venuprasad, M.P., Kandikattu, H.K., Razack, S., Khanum, F. Phytochemical analysis of *Ocimum gratissimum* by LC-ESI – MS/MS and its antioxidant and anxiolytic effects *South Afr. J. Bot.*, Le 2014, 92, 151–158.
- [5] Benitez, N.P., Leon, E.M.M., Stashenko, E.E. Eugenol and methyl eugenol chemotypes of essential oil of species *Ocimum gratissimum* L. and *Ocimum campechianum* Mill. from Colombia. *J. Chromatogr. Sci.* 2009, 47, 800–803.
- [6] K.S. Prabhu, R. Lobo, A.A. Shirwaikar and A. Shirwaikar, *Ocimum gratissimum*: A Review of its Chemical, Pharmacological and Ethnomedicinal Properties, *The Open Complementary Medicine Journal*, 2009, 1, 1-15.
- [7] Iwalokun BA, Gbenle GO, Adewole TA, Smith SI, Akinsinde KA, Omonigbehin EO. Effects of *Ocimum gratissimum* L essential oil at subinhibitory concentrations on virulent and multidrug-resistant *Shigella* strains from Lagos, Nigeria. *APMIS* 2003; 111:477-82.
- [8] Satyavati GV, Gupta AK, Tandon N. *Medicinal Plants of India Vol. 2*. New Delhi (India): Indian Council of Medical Research;1987.
- [9] Kirtikar, K., & Basu, B. *Indian Medicinal Plant*. Dehradun: International Book Distributors, (1999). vol. 1st p 1965.
- [10] Joan Manjuh Tankam, Michiho Ito, Sedative, anxiolytic and antidepressant-like effects of inhalation of the essential oil of *Ocimum gratissimum* L. from Cameroon in mice, *Journal of Pharmacognosy and Phytochemistry* 2014; 2 (5): 1-9.
- [11] Khan, A, H. M. *Muhit-I Azam*. New Delhi: Central Council for Research in Unani Medicine vol 3rd (2013). P 695.
- [12] Baitar, I. *Al-jami Li-mufradat al-adwiya-wal-aghddhiya*. New Delhi:

- Central council for research in unani medicine (1999) vol 3rd P366.
- [13] Ghani, H. N. *Khazain Ul Advia*. New Delhi: Edarah kitab ul ashifa vol 3rd (2011), P 185.
- [14] Kabeeruddin, H. M. *Makhzanul mufradat*. New Delhi: (2014) Idara Kitab-ul-Shifa P 414.
- [15] Nadkarni, K. M. *Indian Materia Medica*. New Delhi: Okhla Industrial Area Phase 1, New Delhi, (1982) vol. IV p 885.
- [16] Anonymous, The wealth of India, National institute of science Communication, CSIR, Dr K S Krishna Marg New Delhi 110012, (1992), vol VII, p no 84
- [17] Hakeem, M. A. *Bustan Ul Mufradat*. New Delhi: Aijaz Publishing House (2011). P172.
- [18] Innocent o and Imosemi. A review of the medicinal values, pharmacological actions, morphological effects and toxicity of *Ocimum gratissimum* Linn. European journal of pharmaceutical and medical research 2020, 7(7),29-40
- [19] Kaliyaperumal Ashokkumar, Arjun Pandian, Muthusamy Murugan, M. K. Dhanya, and Sampathrajan Vellaikumar. Phytochemistry and pharmacological properties of *Ocimum gratissimum* (L.) extracts and essential oil - A critical review. J. Curr. Opin. Crop Sci., 2021; Volume 2(1): 138-148
- [20] John A. Parrotta Healing plant of peninsular India, CABI Publishing 10E 40th Street Suite 3203, New York NY 10016 USA, (2001) P 440.
- [21] Anonymous, Pharmacographia Indica, Srishti book distributors, New Delhi, India (2005) vol 1st, P 85.
- [22] Kabeeruddin, H. M. *Makhzanul mufradat*. New Delhi: Idara Kitab-ul-Shifa. (2014) P414.
- [23] Fofie N'guessan Bra Yvette, Coulibaly Kiyinlma, Kone-Bamba Diénéba, (2014), Pharmacognostic study of *Ocimum gratissimum* Linn.: Pharmafood plant, Journal of Pharmacognosy and Phytochemistry 2014; 2 (5):74-79.
- [24] Offiah VN, Chikwendu UA. Antidiarrhoeal effects of *Ocimum gratissimum* leaf extract in experimental animals. J Ethnopharma 1999; 68:327- 30.
- [25] Nwanjo HU, Oze GO. Hypolipidaemic and Anti-oxidant properties of *Ocimum gratissimum* on Diabetic rats. Plant Prod Res J 2007; 11:1-4.
- [26] Chetia J, Upadhyaya S, Saikia LR. Phytochemical analysis, antioxidant and antimicrobial activity and nutrient content analysis of *Ocimum gratissimum* linn. from Dibrugarh, N.E. India. Int J Pharm Sci Rev Res 2014; 25:229-35.

- [27] Vilioglu YS, Mazza G, Gao L, Oomah BD. Antioxidant activity and total phenolics in selected fruits, vegetables, and grain products. *J Agric Food Chem* 1998; 46:4113-17.
- [28] Akinmoladun AC, Ibukun EO, Afor E, Obuotor EM, Farombi EO. Phytochemical constituent and antioxidant activity of extract from the leaves of *Ocimum gratissimum*. *Sci Res Ess* 2007; 2:163-66.
- [29] Macdonald IO, Oludare AS, Olabiyi A. Phytotoxic and Anti-microbial activities of Flavonoids in *Ocimum gratissimum*. *Life Sci J* 2010; 7:45-48.
- [30] Adeniyi SA, Orjiekwe CL, Ehiagbonare JE, Arimah BD. Preliminary phytochemical analysis and insecticidal activity of ethanolic extracts of four tropical plants (*Vernonia amygdalina*, *Sidaacuta*, *Ocimum gratissimum* and *Telfaria occidentalis*) against beans weevil (*Acanthsceli desobtectus*). *Int J Phy Sci* 2010; 5:753-62.
- [31] Mann Abdullahi. Phytochemical Constituents and Antimicrobial and Grain Protectant Activities of Clove Basil (*Ocimum gratissimum* L.) Grown in Nigeria. *Int J Plant Res* 2012; 2:51-58.
- [32] Vieira RF, Grayer RJ, Paton A, Simon JE., Genetic diversity of *Ocimum gratissimum* L. based on volatile oil constituents, flavonoids and RAPD markers. *Biochem Syst Ecol* 2001; 29:287-304.
- [33] Pino BN, Meléndez Leon EM, Stashenko EE., Eugenol and methyl eugenolchemotypes of essential oil of species *Ocimum gratissimum* L. and *Ocimum campechianum* Mill. from Colombia. *J Chromatogr Sci* 2009; 47:800-3.
- [34] Tharanathan RN, Shamanna D. Composition of *Ocimum gratissimum* shrubby basil seed mucilage. *Indian J Chem* 1975; 13:307-8.
- [35] Habal A. B. Albagdadi, Central Council for Research in Unani Medicine.(2005) Vol 2nd P 230.
- [36] Fred O.J. Oboh, Honeybell I. Masodje and Stephen A., Nutritional and Antimicrobial Properties of *Ocimum gratissimum* Leaves, *Journal of Biological sciences* (4): 377-380, 2009.
- [37] R. K. JOSHI, Chemical Composition, In Vitro Antimicrobial and Antioxidant Activities of the Essential Oils of *Ocimum gratissimum* , O. Sanctum and their Major Constituents, Regional Medical Research Center (Indian Council of Medical Research), Belgaum-590 010, India August 2013.
- [38] Agholor Kin, Lucy M. Yaki, Idris Abubakar, Lucy F. Olusola and Rakiya Zubairu, Antibacterial activity of *Ocimum gratissimum*

- (scent leaf) on some pathogenic gastrointestinal bacteria, African Journal of Microbiology Research, Vol. 12(40), pp. 923-929, 28 October, 2018.
- [39] Adams M, Nwosu CO, Igbokwe IO. Toxicity and phytochemical constituents of aqueous extract of *Ocimum gratissimum* leaf. Nigerian Veterinary Journal, 2008; 29(3): 48-57.
- [40] Orafidiya LO, Agbani EO, Iwalewa EO, Adelusola KA, Oyedapo OO. Studies on the acute and sub-chronic toxicity of the essential oil of *Ocimum gratissimum* L. leaf. Phytomedicine, 2004; 11: 71-76.
- [41] Anthony JP, Fyfe L, Smith H. Plant active components- a resource for antiparasitic agents? Trends in Parasitology, 2005; 21: 462-468.
- [42] Udoha MU, Okoli, NJ, Ijioma SN. Chronic oral administration of *Ocimum gratissimum* leaf extract induced gastrointestinal necrosis in treated albino rats. European Journal of Medicinal Plants, 2019; 27(3): 1-9.
- [43] Shittu ST, Shittu SA, Olatunji AA, Oyeyemi WA. *Ocimum gratissimum* leaf extract may precipitate infertility in male diabetic Wistar rats. JBRA Assisted Reproduction, 2019; 23(1): 34-44. Doi: 10.5935/1518-0557.20180072.